Integrated Device Technology, Inc.

FAST CMOS 18-BIT REGISTER

IDT54/74FCT16823AT/BT/CT/ET
IDT54/74FCT162823AT/BT/CT/ET

FEATURES:

- **Common features:**
  - 0.5 MICRON CMOS Technology
  - **High-speed, low-power CMOS replacement for ABT functions**
  - **Typical $t_{SK(o)}$ (Output Skew) < 250ps**
  - **Low input and output leakage ≤1μA (max.)**
  - ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
  - Packages include 25 mil pitch SSOP, 19.6 mil pitch TSSOP, 15.7 mil pitch TVSOP and 25 mil pitch Cerpack
  - Extended commercial range of -40°C to +85°C
  - V_{CC} = 5V ±10%
- **Features for FCT16823AT/BT/CT/ET:**
  - High drive outputs (-32mA I_{OH}, 64mA I_{OL})
  - Power off disable outputs permit “live insertion”
  - Typical V_{OLP} (Output Ground Bounce) < 1.0V at V_{CC} = 5V, T_A = 25°C
- **Features for FCT162823AT/BT/CT/ET:**
  - Balanced Output Drivers: ±24mA (commercial), ±16mA (military)
  - Reduced system switching noise
  - Typical V_{OLP} (Output Ground Bounce) < 0.6V at V_{CC} = 5V, T_A = 25°C

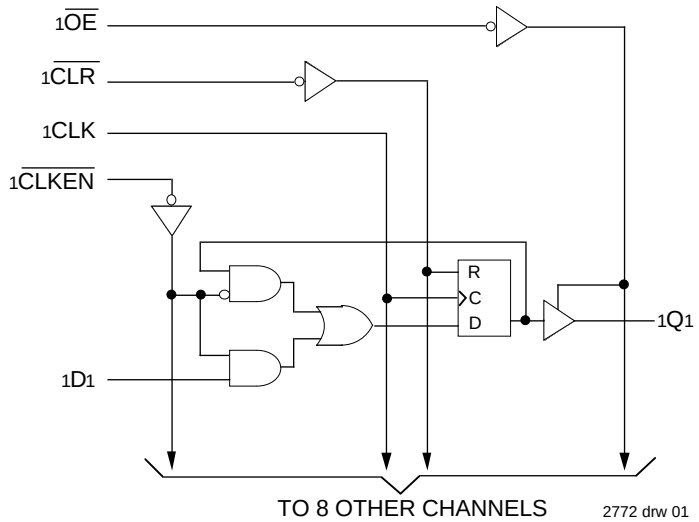
DESCRIPTION:

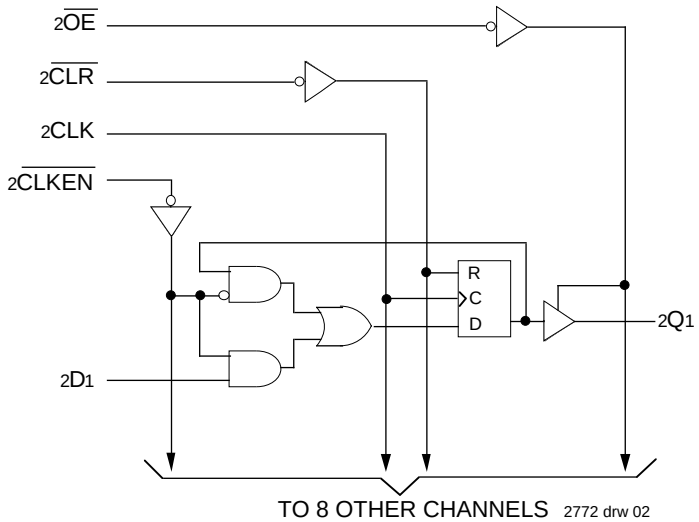
The FCT16823AT/BT/CT/ET and FCT162823AT/BT/CT/ET 18-bit bus interface registers are built using advanced, dual metal CMOS technology. These high-speed, low-power registers with clock enable ($x\overline{CLKEN}$) and clear ($x\overline{CLR}$) controls are ideal for parity bus interfacing in high-performance synchronous systems. The control inputs are organized to operate the device as two 9-bit registers or one 18-bit register. Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

The FCT16823AT/BT/CT/ET are ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability to allow "live insertion" of boards when used as backplane drivers.

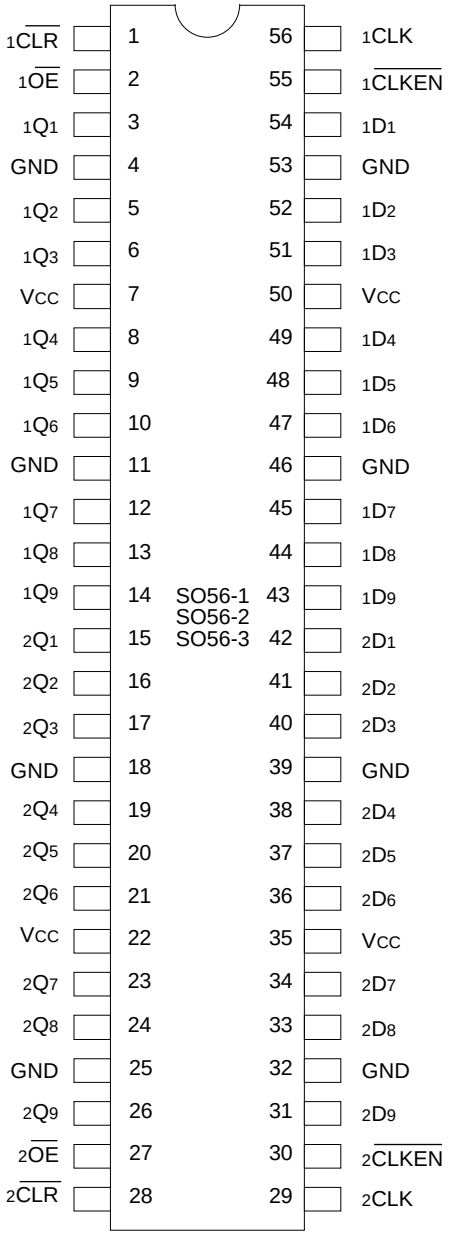
The FCT162823AT/BT/CT/ET have balanced output drive with current limiting resistors. This offers low ground bounce, minimal undershoot, and controlled output fall times – reducing the need for external series terminating resistors. The FCT162823AT/BT/CT/ET are plug-in replacements for the FCT16823AT/BT/CT/ET and ABT16823 for on-board interface applications.

FUNCTIONAL BLOCK DIAGRAM



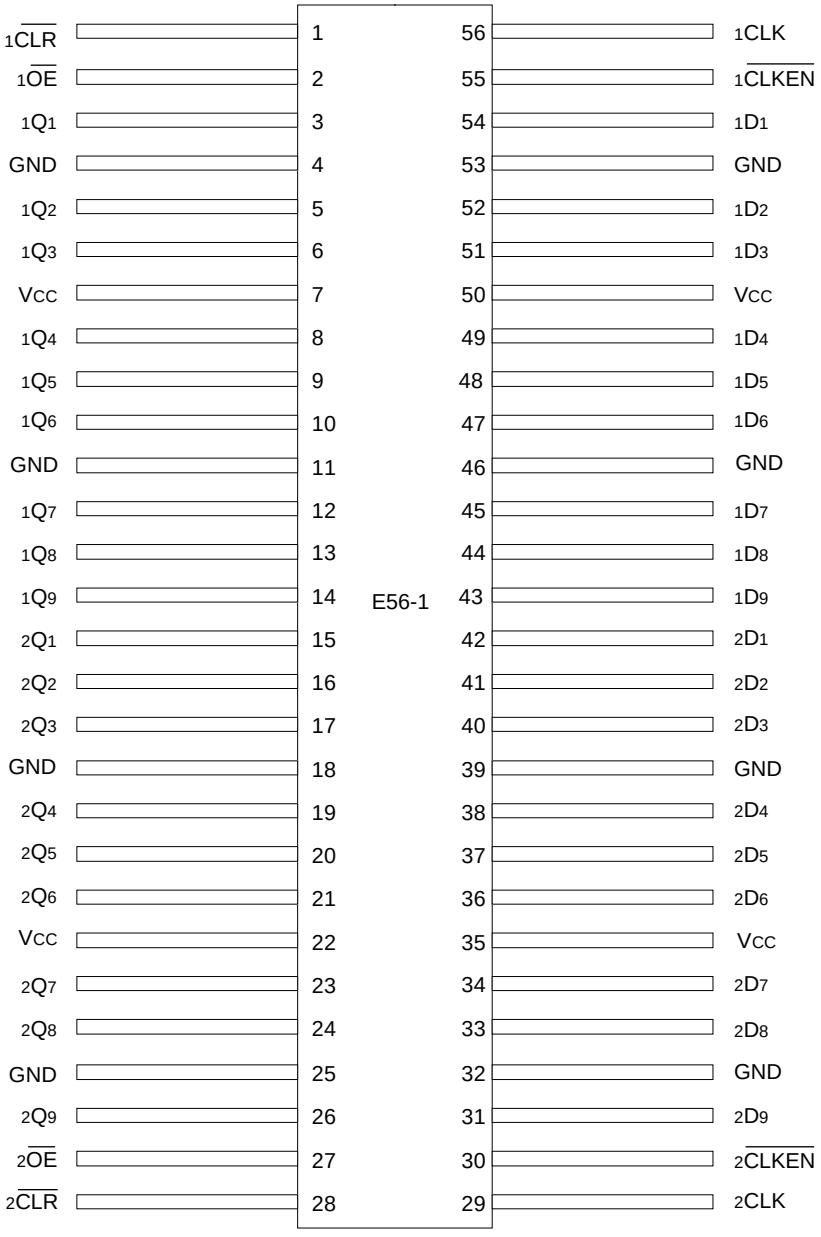


PIN CONFIGURATIONS



SSOP/ TSSOP/TVSOP TOP VIEW

2772 drw 03



CERPACK TOP VIEW

2772 drw 04

PIN DESCRIPTION

Pin Names	Description
xDx	Data inputs
xCLK	Clock Inputs
$x\overline{CLKEN}$	Clock Enable Inputs (Active LOW)
$x\overline{CLR}$	Asynchronous clear Inputs (Active LOW)
$x\overline{OE}$	Output Enable Inputs (Active LOW)
xQx	3-State Outputs

2772 tbl 01

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max.	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +7.0	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to V_{CC} +0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–60 to +120	mA

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NOTES:
1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. All device terminals except FCT162XXXT Output and I/O terminals.
3. Output and I/O terminals for FCT162XXXT.

FUNCTION TABLE(1)

Inputs					Outputs	
$x\overline{OE}$	$x\overline{CLR}$	$x\overline{CLKEN}$	xCLK	xDx	xQx	Function
H	X	X	X	X	Z	High Z
L	L	X	X	X	L	Clear
L	H	H	X	X	Q(2)	Hold
H	H	L	↑	L	Z	Load
H	H	L	↑	H	Z	
L	H	L	↑	L	L	
L	H	L	↑	H	H	

2772 tbl 02

NOTES:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High Impedance
2. Output level before indicated steady-state input conditions were established.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	3.5	6.0	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	3.5	8.0	pF

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NOTE:
1. This parameter is measured at characterization but not tested.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Commercial: T_A = –40°C to +85°C, V_{CC} = 5.0V ± 10%; Military: T_A = –55°C to +125°C, V_{CC} = 5.0V ± 10%

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
V_{IH}	Input HIGH Level	Guaranteed Logic HIGH Level		2.0	—	—	V
V_{IL}	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I_{IH}	Input HIGH Current (Input pins)[5]	V_{CC} = Max.	V_I = V_{CC}	—	—	±1	µA
	Input HIGH Current (I/O pins)[5]			—	—	±1	
I_{IL}	Input LOW Current (Input pins)[5]		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)[5]			—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = 2.7V	—	—	±1	µA
I_{OZL}	(3-State Output pins)[5]		V_O = 0.5V	—	—	±1	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
I_{OS}	Short Circuit Current	V_{CC} = Max., V_O = GND[3]		–80	–140	–225	mA
V_H	Input Hysteresis	—		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		—	5	500	µA

2772 lnk 05

OUTPUT DRIVE CHARACTERISTICS FOR FCT16823T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
I_O	Output Drive Current	V_{CC} = Max., V_O = 2.5V[3]		–50	—	–180	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –3mA	2.5	3.5	—	V
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –12mA MIL. I_{OH} = –15mA COM'L.	2.4	3.5	—	V
			I_{OH} = –24mA MIL. I_{OH} = –32mA COM'L.[4]	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 48mA MIL. I_{OL} = 64mA COM'L.	—	0.2	0.55	V
I_{OFF}	Input/Output Power Off Leakage[5]	V_{CC} = 0V, V_{IN} or $V_O \leq$ 4.5V		—	—	±1	µA

2772 lnk 06

OUTPUT DRIVE CHARACTERISTICS FOR FCT162823T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
I_{ODL}	Output LOW Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		60	115	200	mA
I_{ODH}	Output HIGH Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		–60	–115	–200	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –16mA MIL. I_{OH} = –24mA COM'L.	2.4	3.3	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 16mA MIL. I_{OL} = 24mA COM'L.	—	0.3	0.55	V

NOTES:

2772 lnk 07

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at Vcc = 5.0V, +25°C ambient.
3. Not more than one output should be tested at one time. Duration of the test should not exceed one second.
4. Duration of the condition can not exceed one second.
5. The test limit for this parameter is ± 5µA at T_A = –55°C.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	V_{CC} = Max. V_{IN} = 3.4V[3]		—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open $x\overline{OE}$ = $x\overline{CLKEN}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	75	120	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max. Outputs Open f_{CP}= 10MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	0.8	1.7	mA
		$x\overline{OE}$ = $x\overline{CLKEN}$ = GND at fi = 5MHz 50% Duty Cycle One Bit Toggling	V_{IN} = 3.4V V_{IN} = GND	—	1.3	3.2	
		V_{CC} = Max. Outputs Open f_{CP}= 10MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	4.2	7.1[5]	
		$x\overline{OE}$ = $x\overline{CLKEN}$ = GND at fi = 2.5MHz 50% Duty Cycle Eighteen Bits Toggling	V_{IN} = 3.4V V_{IN} = GND	—	9.2	22.1[5]	

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1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°C ambient.
3. Per TTL driven input (V_{IN} = 3.4V). All other inputs at V_{CC} or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$
   I_{CC} = Quiescent Current (I_{CCL}, I_{CCH} and I_{CCZ})
   ΔI_{CC} = Power Supply Current for a TTL High Input (V_{IN} = 3.4V)
   D_H = Duty Cycle for TTL Inputs High
   N_T = Number of TTL Inputs at D_H
   I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
   f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
   N_{CP} = Number of Clock Inputs at f_{CP}
   f_i = Input Frequency
   N_i = Number of Inputs at f_i

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition[1]	FCT16823AT/162823AT				FCT16823BT/162823BT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLK to xQx	C_L = 50pF R_L = 500Ω	1.5	10.0	1.5	11.5	1.5	7.5	1.5	8.5	ns
		C_L = 300pF[5] R_L = 500Ω	1.5	20.0	1.5	20.0	1.5	15.0	1.5	16.0	
t_{PHL}	Propagation Delay x$\overline{CLR}$ to xQx	C_L = 50pF R_L = 500Ω	1.5	14.0	1.5	15.0	1.5	9.0	1.5	9.5	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OE}$ to xQx	C_L = 50pF R_L = 500Ω	1.5	12.0	1.5	13.0	1.5	8.0	1.5	9.0	ns
		C_L = 300pF[5] R_L = 500Ω	1.5	23.0	1.5	25.0	1.5	15.0	1.5	16.0	
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OE}$ to xQx	C_L = 5pF[5] R_L = 500Ω	1.5	7.0	1.5	8.0	1.5	6.5	1.5	7.0	ns
		C_L = 50pF R_L = 500Ω	1.5	8.0	1.5	9.0	1.5	7.5	1.5	8.0	
t_{SU}	Set-up Time HIGH or LOW xDx to xCLK	C_L = 50pF R_L = 500Ω	4.0	—	4.0	—	3.0	—	3.0	—	ns
t_H	Hold Time HIGH or LOW xDx to xCLK		2.0	—	2.0	—	1.5	—	1.5	—	ns
t_{SU}	Set-up Time HIGH or LOW x$\overline{CLKEN}$ to xCLK		4.0	—	4.0	—	3.0	—	3.0	—	ns
t_H	Hold Time HIGH or LOW x$\overline{CLKEN}$ to xCLK		2.0	—	2.0	—	0	—	0	—	ns
t_W	xCLK Pulse Width HIGH or LOW		7.0	—	7.0	—	6.0	—	6.0	—	ns
t_W	x$\overline{CLR}$ Pulse Width LOW		6.0	—	7.0	—	6.0	—	6.0	—	ns
t_{REM}	Recovery Time x$\overline{CLR}$ to xCLK		6.0	—	7.0	—	6.0	—	6.0	—	ns
$t_{SK(o)}$	Output Skew[3]		—	0.5	—	0.5	—	0.5	—	0.5	ns

2772 tbl 09

NOTES:
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
4. This limit is guaranteed but not tested.
5. This condition is guaranteed but not tested.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

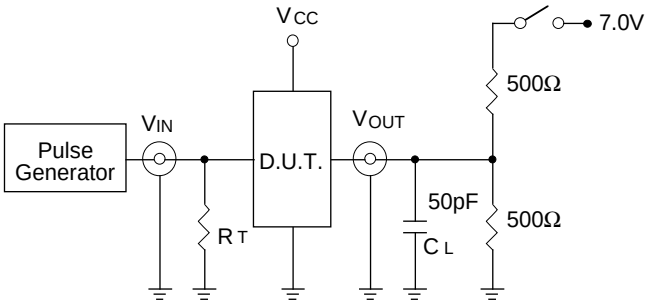
Symbol	Parameter	Condition[1]	FCT16823CT/162823CT				FCT16823ET/162823ET				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLK to xQx	C_L = 50pF R_L = 500Ω	1.5	6.0	1.5	7.0	1.5	4.4	—	—	ns
		C_L = 300pF[5] R_L = 500Ω	1.5	12.5	1.5	13.5	1.5	8.0	—	—	
t_{PHL}	Propagation Delay x$\overline{CLR}$ to xQx	C_L = 50pF R_L = 500Ω	1.5	8.0	1.5	8.5	1.5	4.4	—	—	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OE}$ to xQx	C_L = 50pF R_L = 500Ω	1.5	7.0	1.5	8.0	1.5	4.4	—	—	ns
		C_L = 300pF[5] R_L = 500Ω	1.5	12.5	1.5	13.5	1.5	9.0	—	—	
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OE}$ to xQx	C_L = 5pF[5] R_L = 500Ω	1.5	6.2	1.5	6.2	1.5	3.6	—	—	ns
		C_L = 50pF R_L = 500Ω	1.5	6.5	1.5	6.5	1.5	3.6	—	—	
t_{SU}	Set-up Time HIGH or LOW xDx to xCLK	C_L = 50pF R_L = 500Ω	3.0	—	3.0	—	1.5	—	—	—	ns
t_H	Hold Time HIGH or LOW xDx to xCLK		1.5	—	1.5	—	0.0	—	—	—	ns
t_{SU}	Set-up Time HIGH or LOW x$\overline{CLKEN}$ to xCLK		3.0	—	3.0	—	2.5	—	—	—	ns
t_H	Hold Time HIGH or LOW x$\overline{CLKEN}$ to xCLK		0	—	0	—	0.0	—	—	—	ns
t_W	xCLK Pulse Width HIGH or LOW		6.0	—	6.0	—	3.0[4]	—	—	—	ns
t_W	x$\overline{CLR}$ Pulse Width LOW		6.0	—	6.0	—	3.0[4]	—	—	—	ns
t_{REM}	Recovery Time x$\overline{CLR}$ to xCLK		6.0	—	6.0	—	3.0	—	—	—	ns
$t_{SK(o)}$	Output Skew[3]		—	0.5	—	0.5	—	0.5	—	—	ns

NOTES:
2772 tbl 10

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
4. This limit is guaranteed but not tested.
5. This condition is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



2772 drw 05

SWITCH POSITION

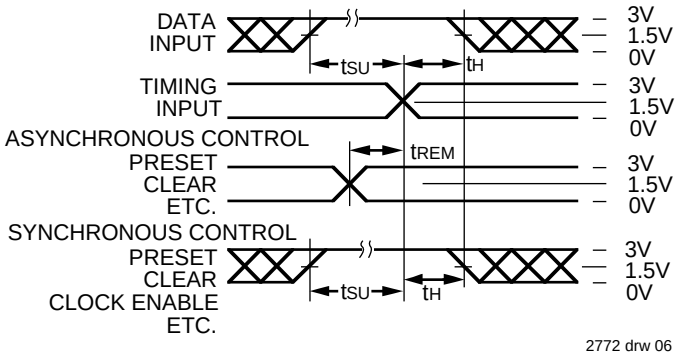
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

2772 lnk 10

DEFINITIONS:

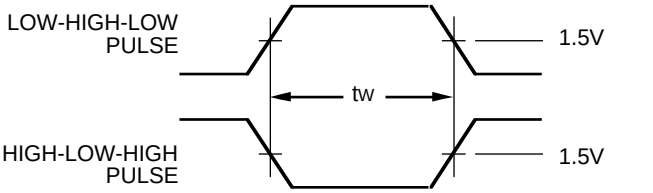
C_L= Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

SET-UP, HOLD AND RELEASE TIMES



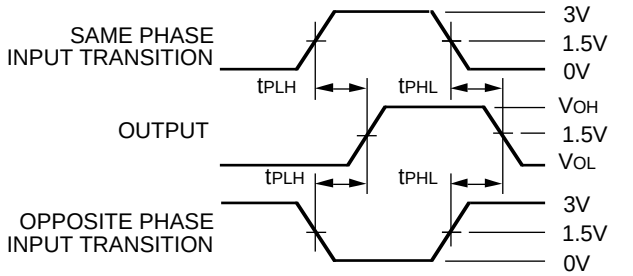
2772 drw 06

PULSE WIDTH



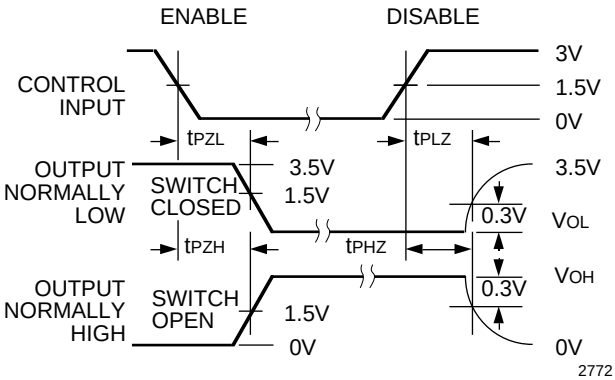
2772 drw 07

PROPAGATION DELAY



2772 drw 08

ENABLE AND DISABLE TIMES

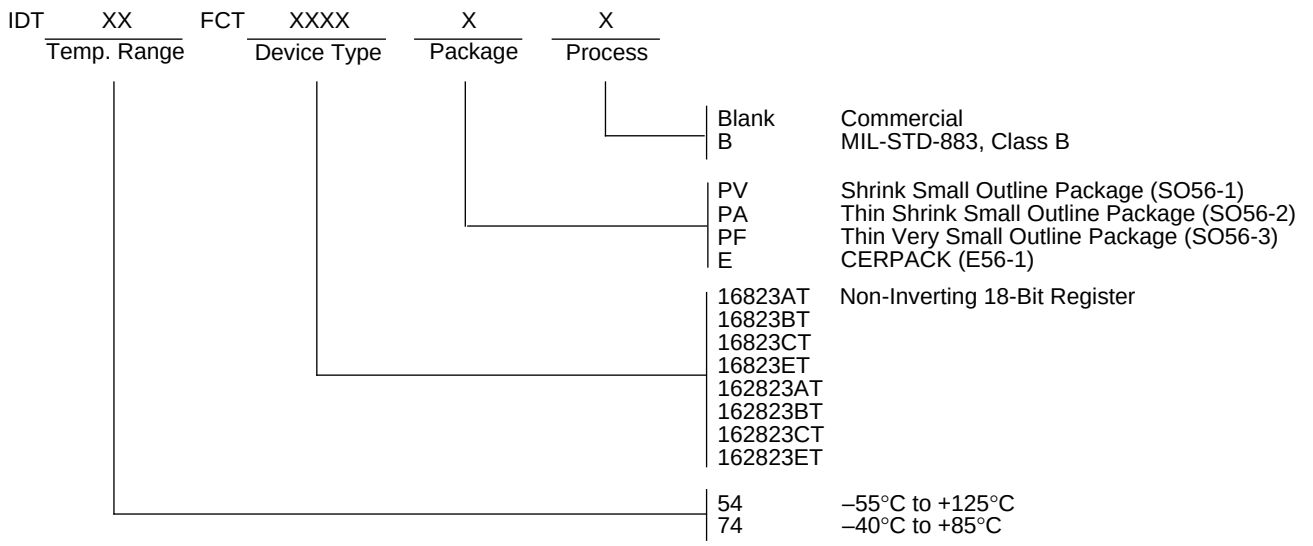


2772 drw 09

NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns

ORDERING INFORMATION



2772 drw 10